The Choice of Solar Energy in the Field of Electrical Generation - Photovoltaic or Solar Thermal - For Arabic Region

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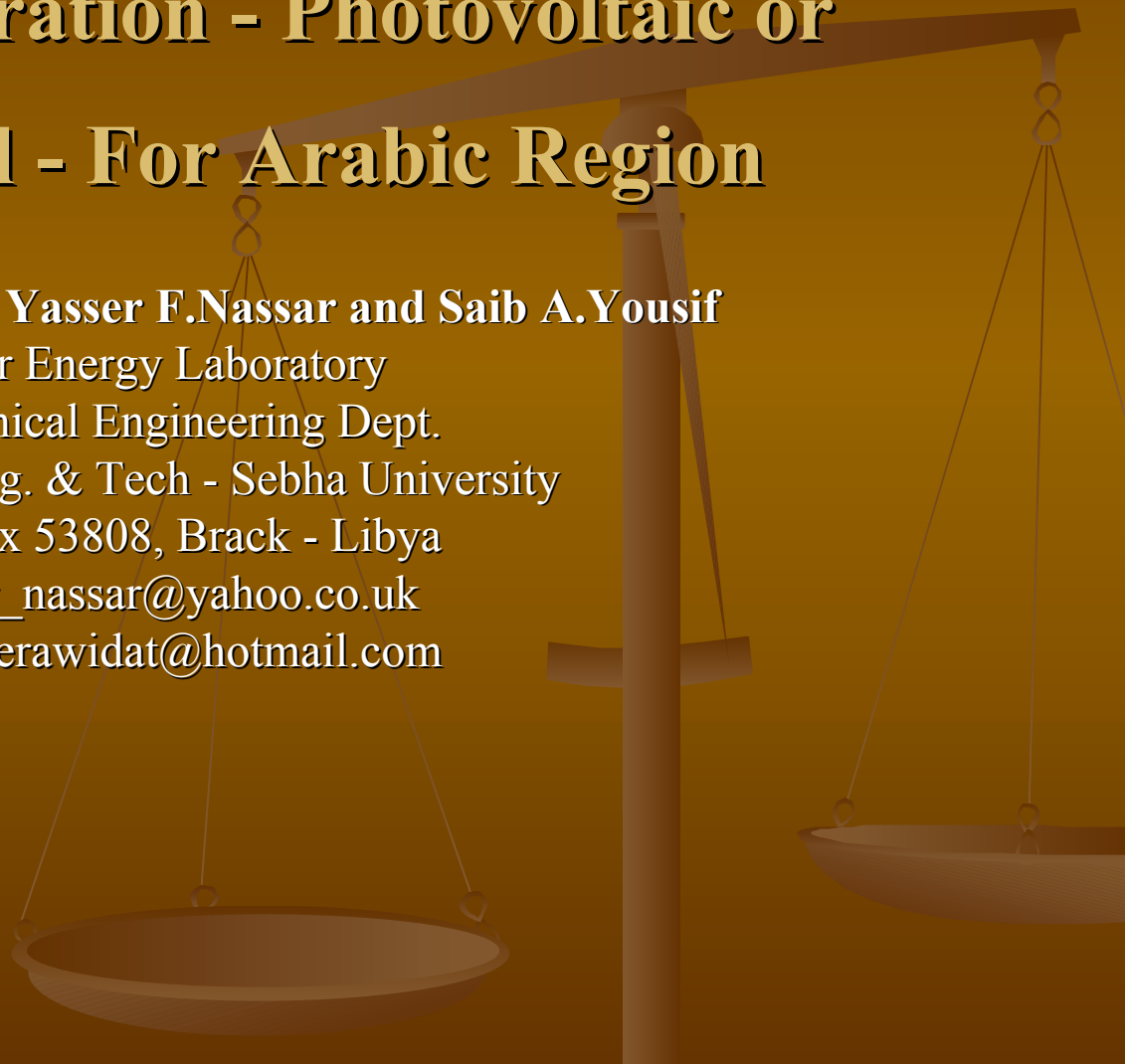

Abstract

- Many countries utilize solar energy to generate electrical power directly by means of photovoltaic cell (PV). In the same time, many of them considered the concentrating solar thermal technique as a source of heat to operate the power generation units
- The paper will give the answer during a comparison between the two technologies, providing a short description of how they work, areas of operation and cost – considerations, availing from other international experiences
- This paper addresses the technical viability and economy of using various types of solar power conversion systems to replace an existing conventional fossil-fuel power plants supply in mainly Arabic countries and the same climatic regions, even for off-grid and rural site

Introduction

- All over the world, electricity remains to be a vital component of national development. Electrical energy is easy to transport and convert to other forms of energy, and available at the flick of a switch, it has kept its place as the main source of energy in commercial and residential applications and in many industrial and transportation applications.
- It accounts for about 40% of the total global energy consumption, and is considered to be a good indicator of economic progress.
- There are increasing challenges facing people throughout the world to secure a reliable, safe and sustainable energy supply to meet their needs
- In developing countries, the demand for` commercial energy is growing quickly. These countries are faced with substantial financial, environmental and energy security problems.
- In both developed and less developed countries pressure is growing to find workable alternatives to traditional energy supplies and to improve the efficiency of energy use in an attempt to limit emissions of gases that cause environmental damage locally and globally

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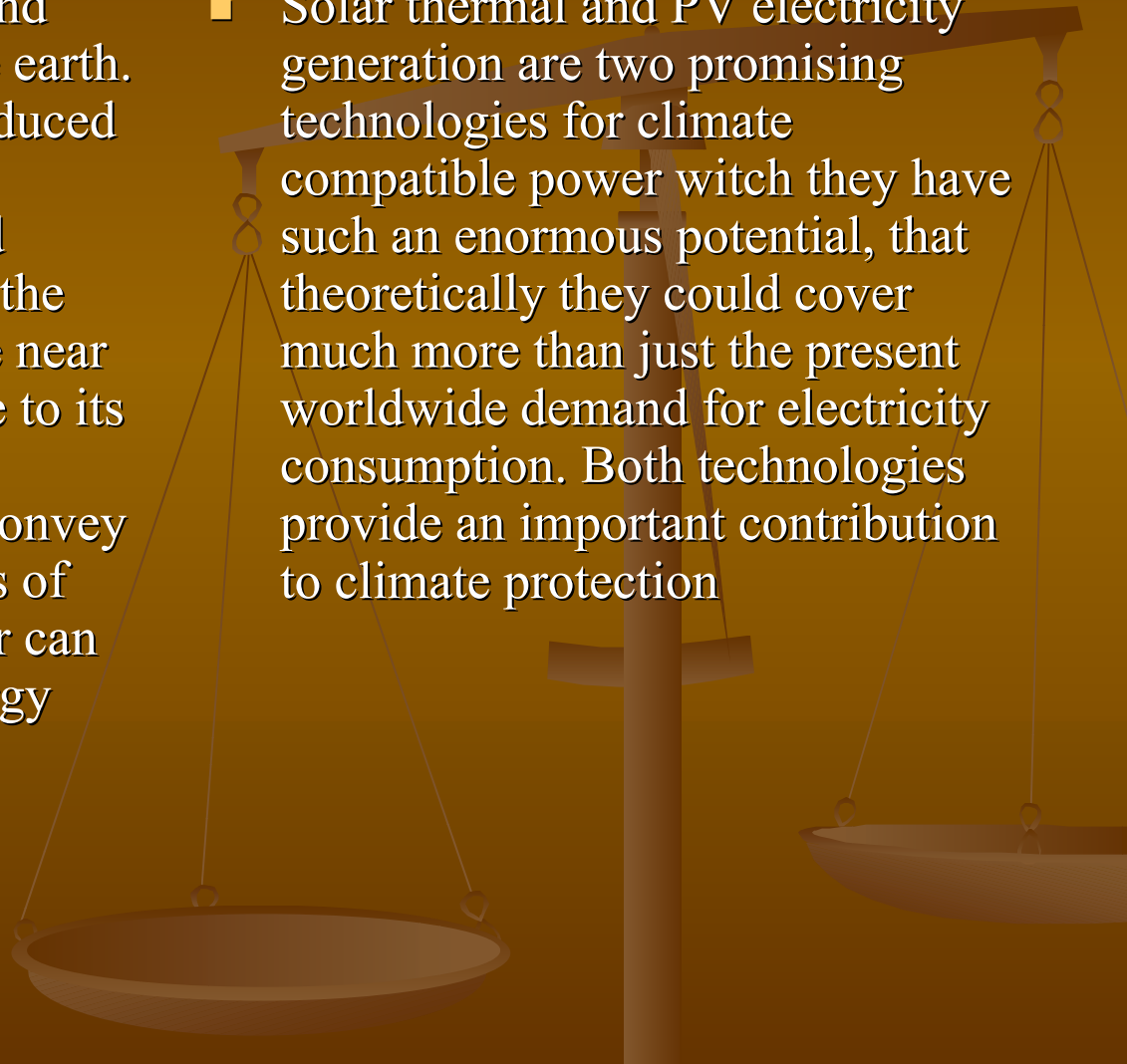
- The implementation of renewable energy systems, make a major contribution to finding solutions to these challenges through stimulating the early implementation of economically viable sustainable energy technologies.
- Technology in the energy sector has always received a lot of attention
- This can be traced to the many technological innovations that have taken place in the past decades. The development of technology is especially geared towards increasing efficiencies and lowering the costs.

Principles

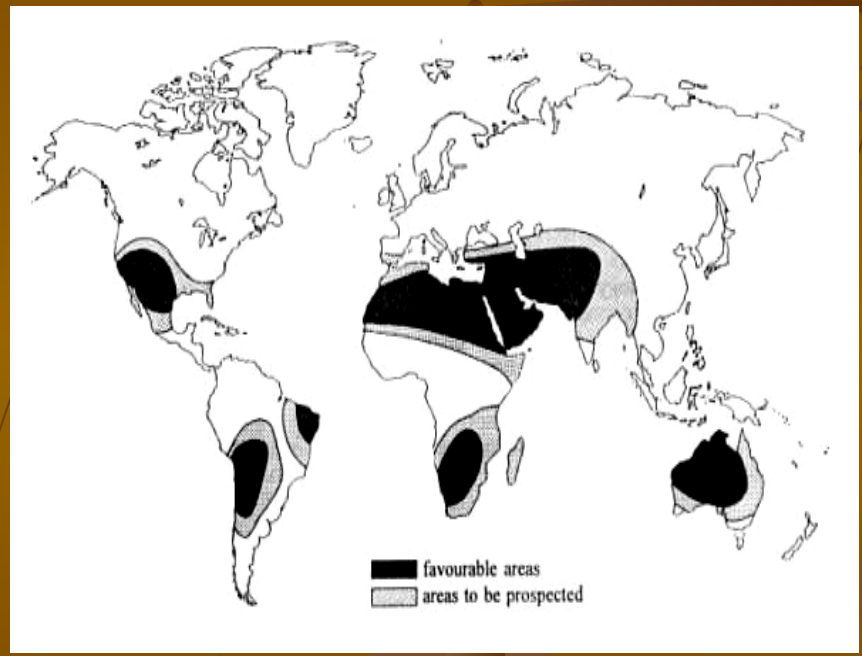
- The sun presents the main and safe source of energy on the earth. As we know the energy produced by fossil fuels causes environmental pollution and contamination, furthermore the risk of there depletion in the near future. Electrical energy due to its characteristics, is the most favorable, and it is easy to convey and convert it to other forms of energy. The electrical power can be extracted from solar energy directly with PV cells and indirectly by means of solar thermal generation
- Solar thermal and PV electricity generation are two promising technologies for climate compatible power witch they have such an enormous potential, that theoretically they could cover much more than just the present worldwide demand for electricity consumption. Both technologies provide an important contribution to climate protection



- Photovoltaic
- Solar Thermal Power Plants

Performance and economical analyses of solar power systems

- Indeed, many scientific studies referred to that, most of the Arabic countries located in area favorable for thermal applications of solar energy such as thermal power generation
- In most of the Arabic countries, the power demand peaks after sunset and into the night, so the alternative must be able to efficiently store solar energy during the sunshine hours
- Only solar power tower technology can operate around the clock and only solar energy alternative that cost-effectively includes storage



The following table compares cost and performance for currently available grid-connectable solar energy alternatives

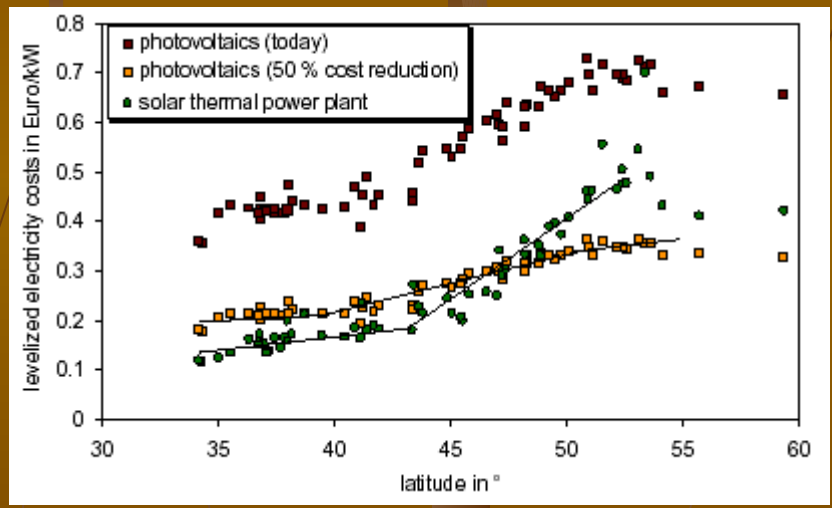
	Cost Effectiveness			Performance		
	Electricity cost of 200 MW plant	Installed cost of energy storage for 200 MW plant	Lifetime of storage system (years)	Annual roundtrip storage efficiency	Maximum capacity factor of optimized system	Annual solar to electric efficiency
Power tower	\$0.06/kWh	\$23/kWh$_e$	30	99%	70%	17%
Synthetic oil parabolic trough	\$0.12/kWh	\$200/kWh$_e$ (appx.)	30	95%	25%**	13%
Photovoltaic with battery storage	\$0.25/kWh	\$650/kWh$_e$*	7.5	76%	24%**	10%

* This investment would be required four times to match lifetimes of the other storage options.

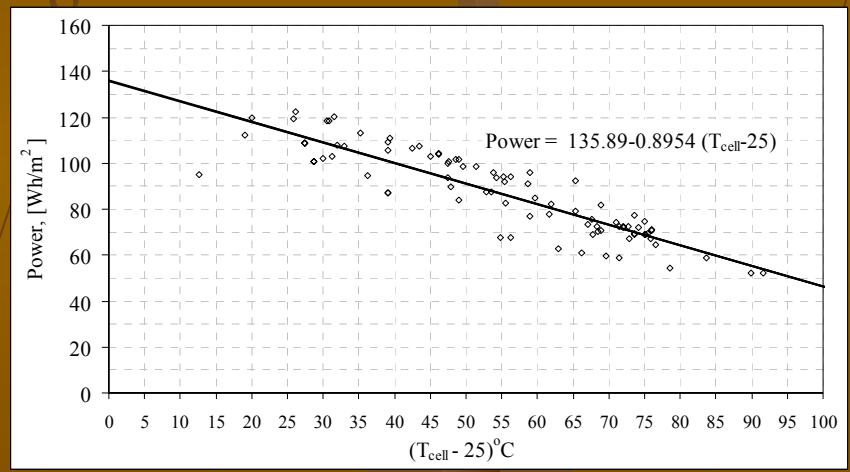
**Because of the high storage cost, economically optimized trough and photovoltaic systems do not

This figure presents the resulting level zed electricity costs for both technologies

- Since market introduction of photovoltaic systems is much more aggressive than that of solar thermal power plants, cost reduction can be expected to be faster for photovoltaic systems. But even if there is a 50% cost reduction in photovoltaic systems and no cost reduction at all in solar thermal power plants.
- Electricity production with solar thermal power plants in southern Europe and North Africa remains more cost-effective than with photovoltaic systems. Therefore, there are areas in which one or the other of the two technologies should be preferred for technical and economic reasons.



- The majority of the thermal solar power plant-unique hardware (heliostats, receiver, storage tanks, reflectors, etc…) can be built in the target place with regional labors. Solar photovoltaic have not this facility, because this technology suffers from high cell costs and high energy storage costs. Besides special-purpose facilities must be built to manufacture the solar cells.
- The photovoltaic system suitability was demonstrated experimentally for the southern region of Libya. As the PV cell is operating at a relatively high temperature with average value about which causes a shortage in the power about 47% of its nominal value



International and Regional Experiences in the exploitation and research in the solar power systems

- Power tower technology has been successfully demonstrated for the Middle-East region The. During the same period.
- The World Bank began providing grants in several countries (such as Mexico, Morocco, Egypt, and India) to adopt new solar technologies (like power towers) to reduce CO2 emissions and meet their power demands.
- The technical and economical feasibility of an Integrated Solar Combined Cycle System (ISCCS) for hybrid fossil/solar power generation in Egypt was assessed by Authorities of the Egyptian Power Sector
- Two technical options for the solar field were analyzed: parabolic trough collectors and power tower with heliostat fields for 90 MWth and 80 MWth.
- The total rated gross capacity of the ISCCS is 127 MWe. At capacity factors of about 80% the annual solar share of the electricity generation by the ISCCS will be 8 to 9%. Annual CO2-avoidance will be about 25,000 tons

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- The exploitation of the PV systems in Libya is very limited and restricted to rural and off-grid communication stations.
- The performance of the PV system providing a solar house located in Sebha City (south Libya) is not efficient, the efficiency reaches 5%.
- The experimental researches achieved by the solar laboratory – Sebha University – indicated that, the failure in the power production by the PV systems was found as high as 47% from the nominal power for Sebha outdoor conditions.
- Due to the high temperature of the PV surface, which effect substantially on PV system efficiency.

Why this paper presented?

- This paper presented an overview of Solar Technologies available and there suitability to applied in theArabic region according to several scientific published works.
- There are some very small PV systems in Libya. But in this paper we talking about the Power manufacturing not for sustain a telecommunication tower with 1500 Watts-Power. According to our researches in this field in Libya, the temperature of the surface's PV cells will be around 100 C which effect negatively on the power.
- The cost of thermal power about 12cents/kWh is better than the cost of the PV about 20 cents/kWh. Because the oil will be depleted, so we are leading to build our Renewable Energy infra-structure in future, by means of the recent fossil fuel, and to contribute with the world in the global war on the pollution. Note that, the project of the combined cycle plant in Egypt was finically supported by the Global Environment Facility (GEF) of World Bank with 50 millions US$.
- the most attractive technology is the solar chimney. Because of: the out power cost will be 0.01-0.02 cents/kWh, and its suitable for the places with a solar radiation not less than 500 W/m2, with minimum 300 sunny days annually, all of these conditions are available in our Sahara desert.

Conclusions

- Solar Thermal and photovoltaic electrical generation are two promising technologies. Photovoltaic systems have advantages for low-power demand. Solar thermal power plants are best operated in large-connected systems. Due to the higher direct solar irradiation in the most of Arabic countries, the thermal solar technologies are more useful and their potential is very high in our Sahara desert.

- This paper addresses the technical viability of using various types of solar power conversion systems to replace the existing conventional fossil-fuel power plants supply in mainly Arabic countries and the same climatic regions, even for off-grid and rural site. The findings of the present study, will therefore, help the electrical authorities to have a realistic picture of the techno-economic aspects in implementing its vision regard solar power generation technologies.